

(12) UK Patent Application (19) GB (11) 2 236 334 (13) A

(43) Date of A publication 03.04.1991

(21) Application No 9018795.6

(22) Date of filing 28.08.1990

(30) Priority data

(31) 45778A89

(32) 29.09.1989

(33) IT

(51) INT CL⁶

D06F 33/02 39/04 58/28

(52) UK CL (Edition K)

D1A AAC ACA AC102

F4G GCRS G201 G301

G1N NAHQ N1A3B N1D13 N4A N7A1

U1S S1226 S1227

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(58) Field of search

UK CL (Edition K) D1A AAC AAD ACA ACC, F4G

GCRS, G1N NAHQ

INT CL⁶ D06F, F28B

Online databases WPI

(54) Washing machine temperature control

(57) A device for controlling the temperature to which the washing bath or the drying air for the laundry is heated in a combined washing and drying machine for laundry comprises at least two electrical heating elements (11, 12) for the washing bath and for the drying air respectively, and a single temperature sensor (15) which is adapted to measure each temperature selectively. The control device includes at least two electronic comparators (16, 17) for connecting and disconnecting one or other of the heating elements (11, 12) in dependence on their selective connection to the temperature sensor (15) by a switch (18) and in dependence on a comparison of the voltage levels generated by the sensor (15) during the heating of the washing bath or the drying air with predetermined reference voltages.

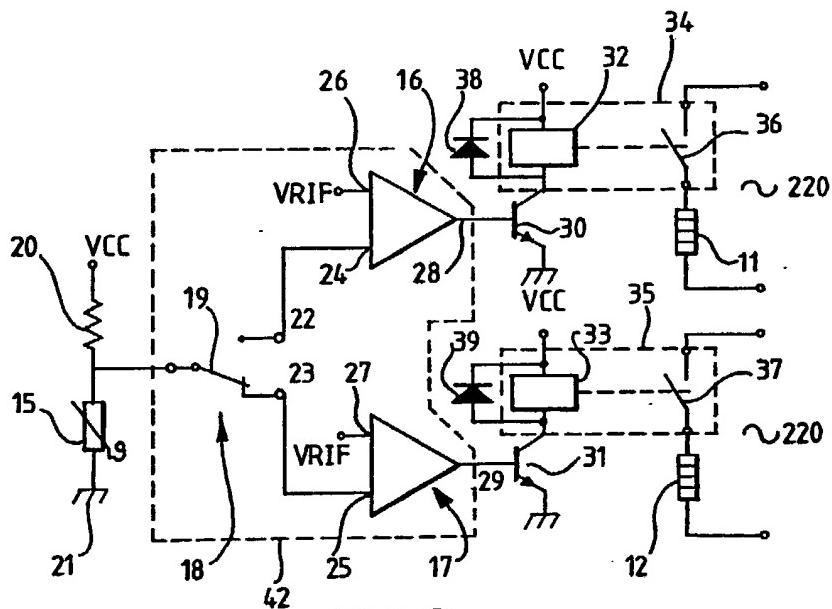


FIG.2.

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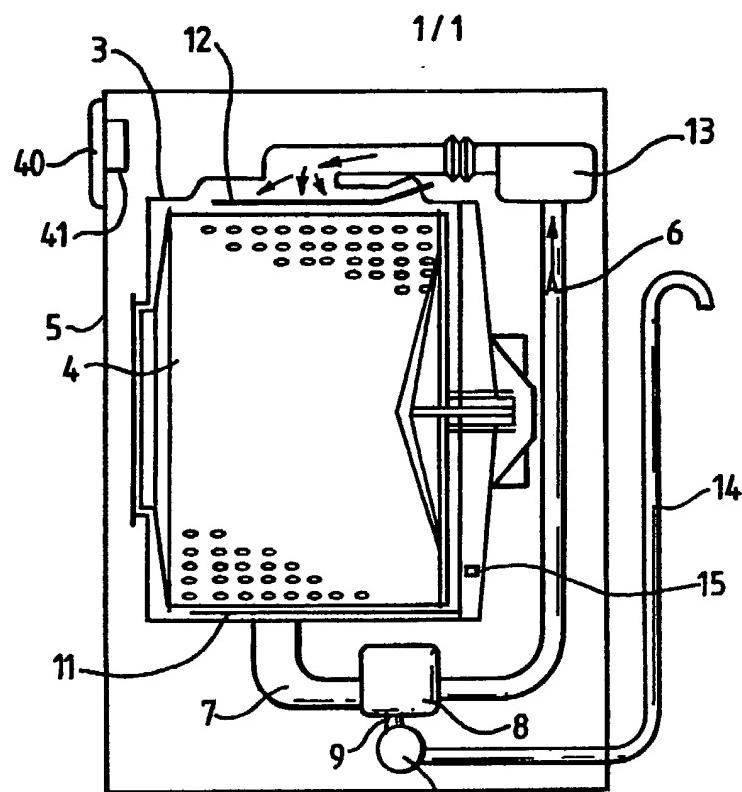


FIG. 1.

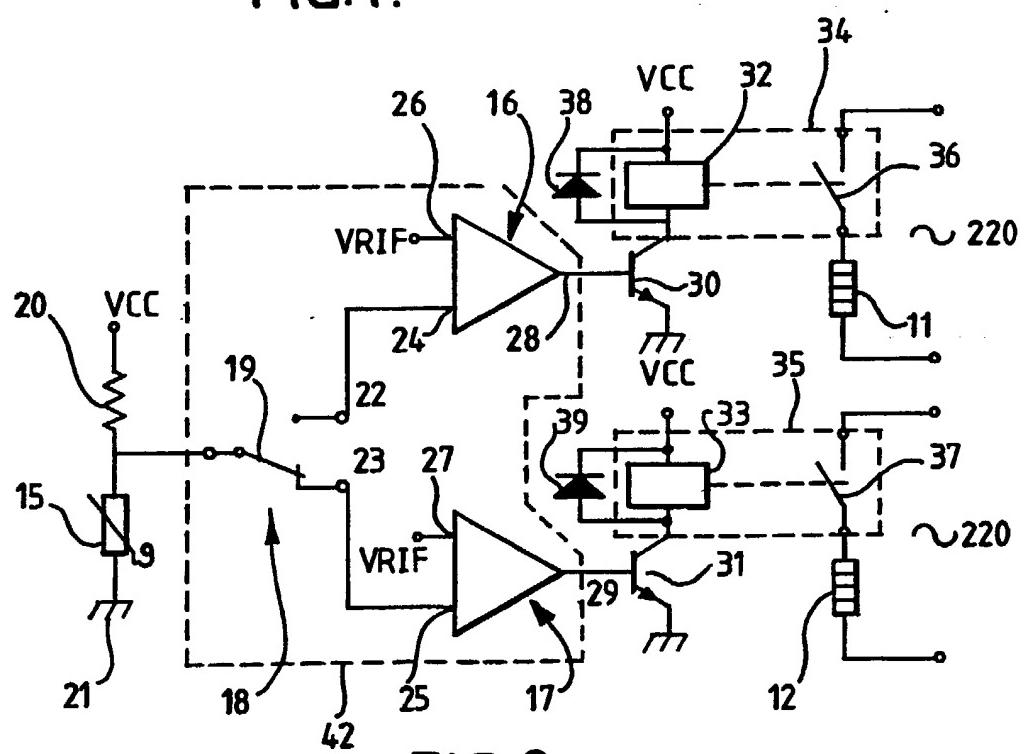


FIG. 2.

A TEMPERATURE -CONTROL DEVICE FOR COMBINED WASHING
AND DRYING MACHINES FOR LAUNDRY

The invention relates to a device for controlling the washing and drying temperatures in combined washing and drying machines for laundry, having a single sensor for regulating both the washing temperature and the drying temperature.

Combined washing and drying machines for laundry are known in which the laundry, which is put in a drum rotatable in a tub containing a conventional washing bath, is subjected in succession to a series of washing cycles and, once these have been completed and the washing bath has been drained from the tub, to a series of drying cycles which are carried out by the circulation of an air flow, produced by a corresponding fan and heated by at least one conventional heating element, through a separate duct communicating with the lower and upper parts of the tub so as progressively to dry the wet washing in the drum.

In these combined machines, the temperature to which the washing bath is heated by its heating element in the tub is regulated by means of a suitable sensor, such as, for example, an NTC probe or a conventional expansible-fluid thermostat provided in the case of electronic temperature control and of the use of electromechanical timers in association with the thermostat respectively, which is housed in the tub and is adapted to connect and disconnect the heating element repeatedly until the predetermined regulation temperature is reached in the washing bath. Similarly, the temperature of the flow of hot, drying air is regulated by the continuous connection of the various branch circuits constituting the heater element

by means of the timer of the equipment, or by the thermostatic control of the temperature with the use of at least one conventional bimetallic thermostat associated with the heater element.

The present invention relates to a device for controlling the temperatures of the washing bath and of the hot air-flow for drying the laundry in combined washing and drying machines for laundry which is structurally simple and enables the temperatures to be regulated with the use of only one conventional sensor instead of two as in the prior art. This temperature-control device has the structural characteristics substantially as described with particular reference to the claims of the present patent.

The invention will become clearer from the following description, given purely by way of non-limiting example with reference to the appended drawings, in which:

Fig. 1 shows schematically a combined washing and drying machine for laundry provided with the control device according to the invention;

Fig. 2 shows the electrical circuit diagram of the present control device.

Figure 1 shows schematically a laundry-drying machine, and in particular a combined washing and drying machine for laundry, constituted essentially by a washing tub 3 supported in conventional manner within a housing 5 of the machine and containing a rotary drum 4 in which the laundry is placed and from which it is removed, as

well as by a duct 6 for the circulation of hot air for drying the laundry connected to the lower part of the tub 3 by means of a flexible tube 7, and a waste collector 8 which has a union 9 connected to the waste pump 10 of the machine, the circulation duct also being connected to the top part of the tub.

The present combined machine also includes at least one electrical heating element 11 in the washing tub 3, or in an external manifold connected thereto in the case of a recirculating washing machine, for heating the washing bath introduced into the tub for carrying out the usual washing cycles, as well as at least one further electrical heating element 12 in the upper region of the tub 3 and a fan 13 in the circulation duct 6 for circulating the air heated by the heating element 12 in a closed circuit through the duct and into the drum 4 in the direction of the arrow A.

The machine in question can thus carry out the conventional washing cycles, at the end of which the washing bath is drained from the tub 3 through the flexible tube 7, the waste collector 8 and the waste pipe 14 connected to the pump, by virtue of the action of the waste pump 10.

After washing, this machine can also carry out the conventional drying cycles by circulating the hot air through the drum 4 by means of the fan 13 and the heating element 12. In order to regulate thermostatically both the temperature of the washing bath during the washing cycles and that of the hot air during the drying cycles, the machine in question also includes at least one sensor 15 of known type constituted, for example, by an NTC sensor, connected

operatively to both the heating elements 11 and 12 in the manner which will be described below and positioned so that it can effectively monitor the temperature of the washing bath and, upon completion of the washing, also the temperature of the hot, drying air. Purely by way of example, a suitable position for achieving this dual measurement capability may be within the tub 3 above the associated heating element 11 or, in the case of a recirculating washing machine, in the flexible tube 7 above the switch-off level of the waste pump 10 but, naturally, it may also be in other regions of the machine which are located in correspondence with the washing bath and the subsequent hot air flow without thereby departing from the scope of protection of the present invention. With reference now to Figure 2, which shows the electrical circuit diagram of the present temperature-control device, it can be seen that it comprises essentially at least two electronic comparators 16 and 17, or similar devices for comparing electrical quantities, which are adapted to connect and disconnect the heating element 11 for the washing bath and the heating element 12 for the hot, drying air respectively in the manner which will be described below, and also includes an electrical switch 18 for the selective connection of one or other of the comparators 16, 17 to the NTC sensor 15.

In particular, the switch 18 is constituted by a movable electrical contact 19 connected to a terminal of the NTC sensor 15, together with a resistance 20 supplied with a direct-current voltage Vcc, the other terminal of the sensor being earthed at 21 and the movable contact being switchable to one or other of the fixed electrical contacts 22 and 23 of the switch which are connected in turn to respective first inputs 24 and 25

of the comparators 16 and 17. Moreover, the respective second inputs 26 and 27 of the two comparators 16 and 17 are connected to the same predetermined direct-current reference voltage V_{rif} , whilst the respective outputs 28 and 29 are connected by respective driver transistors 30 and 31 to corresponding electromagnets 32 and 33 of associated relays 34 and 35 for connecting and disconnecting the respective electrical heating elements 11 and 12. For this purpose, the relays 34 and 35 include respective movable electrical contacts 36 and 37 which are arranged in series with the respective heating elements 11 and 12 and can be opened or closed by the associated electromagnets 32, 33 of the relays according to whether they are in the de-energised or the energised condition, thereby disconnecting or connecting the heating elements. Finally, the other terminals of both electromagnets 32 and 33 are connected to the aforesaid direct-current voltage V_{cc} and are arranged in parallel with respective protection diodes 38 and 39. The operation of the temperature-control device according to the invention is thus clear.

In fact, as soon as the machine has been set for the respective washing and drying cycles to be carried out by the operation of the selection knob 40 associated with the timer 41 of the machine, the machine automatically switches the movable contact 19 of the switch 18 to the fixed contact 22, thus arranging for the heating element 11 for the washing bath to be connected and disconnected exclusively by the comparator 16 throughout the duration of the washing cycles selected. In this condition, therefore, the machine is arranged to carry out the washing cycles controlled by the timer 41 which thus causes the

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admission to the tub of the washing bath whose temperature is monitored constantly by the NTC sensor 15. Since, to begin with, the washing bath is at ambient temperature and the heating element 11 is disconnected, the NTC sensor 15 generates a corresponding maximum direct-current voltage which is applied through the movable contact 19 of the switch 18 to the first input 24 of the comparator 16.

As this voltage is greater than the reference voltage V_{rif} applied to the second input 26 of the comparator, the output 28 of the latter is switched, in the present embodiment, to a high level "1", thus making the transistor 30 conductive and energising the electromagnet 32 which closes the movable contact 36 of the relay 34 so as to connect the heating element 11 thereby starting the heating of the washing bath.

The consequent rise in the temperature of the bath causes a decrease in the resistance of the NTC sensor 15 which therefore generates decreasing direct-current voltages which are applied to the first input 24 of the comparator 16 and which keep the output 28 of that comparator unchanged, and hence keep the heating element connected, as long as their level is higher than that of the reference voltage V_{rif} of the other input 26 of the comparator.

As soon as the washing bath has reached a temperature such that the NTC sensor 15 generates a direct-current voltage equal to the aforesaid reference voltage V_{rif} , the comparator 16 switches its output 28 from the high level "1" to a low level "0", thus cutting off the transistor 30 and de-energising the electromagnet 32 which therefore opens the movable contact 36 of the

relay 34 to disconnect the heating element 11 and stop the heating of the washing bath. The sequence just described for the connection and disconnection of the heating element 11 is repeated in the same manner whenever the washing cycles selected provide for various stages of heating of the washing bath in which the various temperatures are achieved by corresponding variations in the level of the reference voltage V_{rif} .

At the end of each selected washing cycle, the timer 41 switches the movable contact 19 of the switch 18 to its other operative position, moving it to the fixed contact 23 of the switch and thus arranging the machine to carry out the drying cycles with control of the temperature by means of the same NTC sensor 15 and the remaining comparator 17, the element 12 for heating the drying air being connected and disconnected in the manner described. Naturally, instead of those described in the present embodiment, different electrical components may be used in combination with at least two electronic comparators which can be selected by a switch connected to a single sensor for measuring the temperature of the washing bath and of the air for drying the laundry, provided that the function specified above is still achieved. Moreover, according to the invention, it is also possible, to advantage, to incorporate the low-voltage components, such as, for example, the comparators 16 and 17 and the electrical switch 18, in a microprocessor 42 (shown in broken outline). The temperature control device thus formed is simple and reliable and, moreover, achieves the dual function of regulating the temperatures of the washing bath and of the drying hot air in combined washing and drying machines for laundry, with the elimination of one temperature sensor.

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CLAIMS

- 1) A device for controlling the washing and drying temperatures in combined washing and drying machines for laundry, comprising at least one first and at least one second element for heating the washing bath and the drying air for the laundry respectively, as well as at least one sensor for monitoring the respective temperatures to which the washing bath and the drying air are heated, and comparison means for selectively connecting and disconnecting the heating elements by means of respective control means, characterised in that the comparison means comprise at least one first and at least one second electronic comparator (16, 17) or the like with respective first inputs (24, 25) connected to the temperature sensor (15) through switch means (18) and respective second inputs (26, 27) connected to reference voltages of predetermined levels, as well as respective outputs (28, 29) connected to the first and second heating elements (11, 12) respectively by means of the control means (30, 31, 32, 33; 38, 39; 36, 37), the first inputs (24, 25) of the first and second comparators (16, 17) being connectible selectively to the temperature sensor (15) by means of the switch means (18) in order to connect and disconnect the first and second heating elements (11, 12) selectively in dependence on a comparison of the voltage levels generated by the temperature sensor (15) during the heating of the washing bath or of the drying air respectively with the respective reference voltage.
- 2) A control device according to Claim 1, characterised in that the first and second comparators (16, 17) and the switch means (18) are incorporated in a

microprocessor (42).